Amendments to the Claims:

Claims 1 – 7. (canceled)

Claim 8. (currently amended) An adaptive control system (ACS) for controlling a plant based on at least one commanded output signal y_c and an rth time-derivative of the commanded output signal $y_c^{(r)}$, and a plant output signal y that is a function of the states existing in the plant, r being the relative degree of the plant output signal y, the ACS comprising:

a model inversion unit (MIU) coupled to receive a pseudo-control signal ν and a plant output signal y, the MIU generating a control signal δ_c by inverting an approximate model of the plant dynamics, the MIU supplying the control signal δ_c to the plant for control thereof;

a summing unit coupled to receive the rth time-derivative of the commanded output signal $y_c^{(r)}$, a pseudo-control component signal ν_{dc}, and an adaptive control signal ν_{ad}, the summing unit adding the rth time-derivative of the commanded output signal $y_c^{(r)}$ and the pseudo-control component signal ν_{dc}, and subtracting the adaptive control signal ν_{ad}, to generate the pseudo-control signal ν;

an error signal generator (ESG) coupled to receive the commanded output signal y_c and optional derivatives thereof and the plant output signal y, the ESG generating a tracking error signal $\tilde{y}$ by differencing corresponding signal components of the commanded output signal y_c and optional derivatives thereof, and a plant output signal y;

a linear controller having a linear dynamic compensator (LDC) coupled to receive the tracking error signal $\tilde{y}$, the LDC generating [[a]] the pseudo-control component signal ν_{dc} based on the tracking error signal $\tilde{y}$, the pseudo-control component signal ν_{dc} for stabilizing the feedback linearized dynamics of the model inverted in the [[model inversion unit]] MIU, the LDC generating a transformed signal $\tilde{y}_{ad}$ based on the tracking error signal $\tilde{y}$ so that a transfer function from an adaptive control signal ν_{ad} to the transformed signal $\tilde{y}_{ad}$ is strictly positive real (SPR);

an adaptive element having

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an error conditioning element coupled to receive the transformed signal $\tilde{y}_{ad}$ and at least one neural network basis function ϕ, the error conditioning element stable low-pass filtering the basis function ϕ to produce a filtered basis function ϕ_f and multiplying the filtered basis function ϕ_f by the transformed signal $\tilde{y}_{ad}$ to produce a training signal δ; and

a neural network adaptive element (NNAE) coupled to receive the plant output signal y, the pseudo-control signal [[v_{ad}]] $\underline{v}$, and the training signal δ, the NNAE having a neural network generating the adaptive control signal v_{ad} based on the plant output signal y and the pseudo-control signal [[v_{ad}]] $\underline{v}$ supplied as inputs to the neural network, the neural network generating the adaptive control signal v_{ad} by mapping the plant output signal y and a pseudo-control signal v to the adaptive control signal v_{ad} based on at least one basis function ϕ and at least one connection weight W~~-that is an output signal from the neural network~~, <u>the neural network coupled to output the basis function ϕ to the error conditioning element,</u> the adaptive element using the training signal δ to update the basis function ϕ and at least one connection weight W of the neural network so that the adaptive control signal v_{ad} generated by the neural network is bounded.

9. (currently amended) An ACS as claimed in claim 8 wherein the LDC maps the tracking error signal $\tilde{y}$ to the pseudo-control component signal v_{dc} based on a transfer function $N_{dc}(s) / D_{dc}(s)$, and the LDC maps the tracking error signal $\tilde{y}$ to the transformed signal $\tilde{y}_{ad}$ based on a transfer function $N_{ad}(s) / D_{dc}(s)$, the transfer functions $N_{dc}(s) / D_{dc}(s)$ and $N_{ad}(s) / D_{dc}(s)$ selected to assure boundedness of the tracking error signal $\underline{\tilde{y}}$.

10. (previously presented) An ACS as claimed in claim 8 further comprising:

a delay element coupled to receive the plant output signal y and generating at least one delayed plant output signal y_d as an additional input signal to the neural network to generate the adaptive control signal v_{ad}.

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11. (previously presented) An ACS as claimed in claim 8 further comprising:

a delay element coupled to receive the pseudo-control signal v and generating at least one delayed pseudo-control signal v_d, the delay element coupled to supply the delayed pseudo-control signal v_d as an additional input signal to the neural network to generate the adaptive control signal v_{ad}.

12. (previously presented) An ACS as claimed in claim 8 wherein the plant comprises at least one sensor sensing at least one state of the plant, and generating the plant output signal y based on the sensed plant state.

13. (previously presented) An ACS as claimed in claim 8 wherein the plant comprises at least one actuator controlling the plant based on the command control signal δ_c.

14. (previously presented) An ACS as claimed in claim 8 wherein the ACS is operated by a human operator, the ACS further comprising:

an operator interface unit coupled to receive the plant output signal y, the operator interface unit generating a display signal based on the plant output signal y;

the operator receiving the display signal from the operator interface unit, and producing control action to control the plant based on the display signal; and

a command filter unit operable by the operator, the command filter unit generating the commanded output signal y_c, and optional derivatives thereof, and the rth derivative $y_c^{(r)}$ of the plant output signal y based on control action of the operator.

15. (previously presented) An ACS as claimed in claim 8 further comprising:

an operator interface unit coupled to receive the plant output signal y, the operator interface unit generating a signal based on the plant output signal y;

an operator coupled to receive the signal generated by the operator interface unit, and generating an operator signal to control the plant based on the signal generated by the operator interface unit; and

a command filter unit operable by the operator, the command filter unit generating the commanded output signal y_c and optional derivatives thereof, and the rth derivative $y_c^{(r)}$ of the plant output signal y based on the operator signal.

16. (canceled)

17. (previously presented) An adaptive element (AE) of an adaptive control system (ACS) for controlling a plant based on a plant output signal y that is a function of the full plant state existing in a plant, a pseudo-control signal v used to control the plant, and a transformed signal $\tilde{y}_{ad}$ from a linear controller of the ACS, the adaptive element comprising:

a neural network adaptive element (NNAE) comprising a neural network having at least one connection weight W and at least one basis function ϕ, the neural network coupled to receive the pseudo-control signal v and the plant output signal y;

a delay element coupled to receive the plant output signal y and the pseudo-control signal v, and generating signals y_d, v_d that are delayed versions of the plant output signal y and the pseudo-control signal v; and

an error conditioning element coupled to receive the transformed signal $\tilde{y}_{ad}$ and the basis function ϕ, and generating an error signal δ based thereon,

the NNAE coupled to receive the error signal δ and adapting the connection weight W and the basis function ϕ to adaptively control unmodeled plant dynamics.

18. (previously presented) An adaptive element as claimed in claim 17 wherein the error conditioning element includes a filter and a multiplier, the filter operating on the basis function ϕ from the NNAE to produce a filtered basis function ϕ_f, the multiplier generating the error signal δ by multiplying the filtered basis function ϕ_f by the transformed signal $\tilde{y}_{ad}$.

19. (currently amended) An adaptive element as claimed in claim 18 wherein the filter operates on the basis function ϕ to produce the filtered basis function ϕ_f using a

transfer function [[$T^{-1}(s)$]] $\underline{T'(s)}$ that ensures boundedness of the connection weight W and [[the]] a tracking error signal $\tilde{y}$ generated by differencing a commanded output signal y_c and the plant output signal y, the tracking error signal $\tilde{y}$ provided to the linear controller of the ACS to generate the transformed signal $\tilde{y}_{ad}$ and the pseudo-control signal $\underline{\nu}$.

Claims 20 - 30 (canceled)